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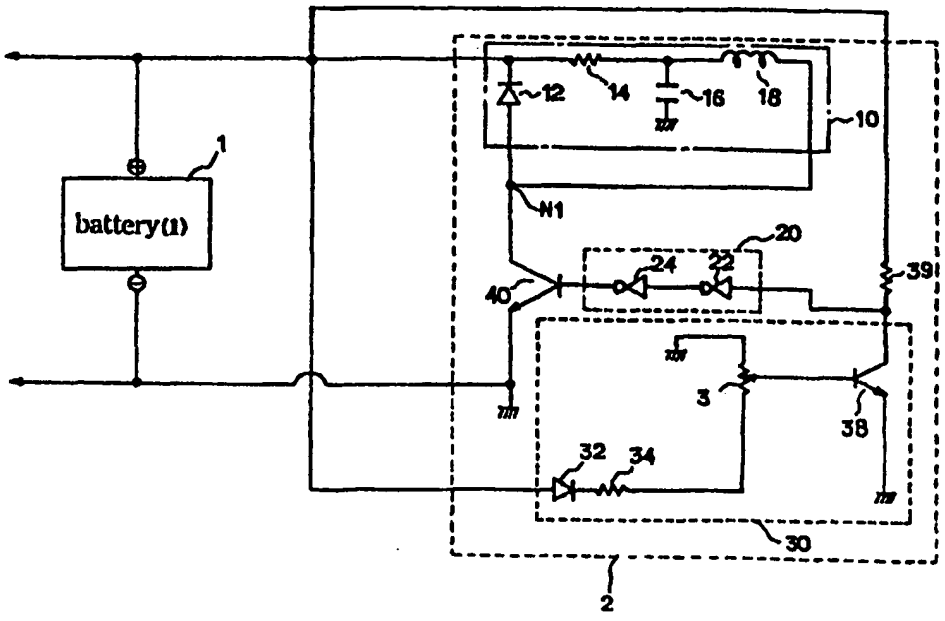
(54) Title: LIFE SPAN LENGTHENING DEVICE FOR EFFICIENT USE OF BATTERY

(57) Abstract

The life span lengthening device of a battery having an advanced performance, which is capable of doubling a use efficiency of the battery by re–energizing crystallized sulfate SO_4 accumulated on a polar plate through a use of a direct current pulse onto the battery and by returning it as activated sulfur molecules to electrolyte of the battery, comprises a state monitoring part for sensing a case that voltage higher than maintenance voltage of the battery is applied to an interval of first and second power terminals of the battery and generating a driving signal; and a pulse generating part for generating direct current pulse in response to the driving signal of the state monitoring part and providing it to the first power terminal of the battery.



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LIFE SPAN LENGTHENING DEVICE FOR EFFICIENT USE OF BATTERY

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates to a circuit device for a performance improvement and life span lengthening of a lead storage battery

Discussion of Related Art

A battery generally performs its own function through a cycle of a discharge and a charge, the discharge being that chemical energy is changed to electric energy, the charge being that the electric energy is changed to the chemical energy. In a general battery as a lead storage battery, a specific gravity of the battery becomes low through a combination of sulfate SO_4 with a polar plate so as to generate water in a case of the discharge, and in a case of the charge, the combined sulfate is returned to electrolyte to thereby heighten the specific gravity of the battery. That is, such battery is a storage battery of lead provided by applying the Galvani Battery thereto. The lead storage battery is formed by electrodes of lead dioxide PbO_2 and lead Pb soaked in a thick sulfuric acid water-solution, and also has an occurrence of a battery reaction as follows.

positive pole :

$Pb(s) + HSO_4^- \text{ ------> } PbSO_4(s) + H^+ + 2e^-$

negative pole :

$PbO_2(s) + HSO_4^- + 3H^+ + 2e^- \text{ -----> } PbSO_4(s) + 2H_2O$

battery :

$Pb(s) + Pbo_2(s) + 2HSO_4^- + 2H^+ \text{ -----> } 2PbSO_4(s) + 2H_2O$

A reaction of two electrodes is to generate $PbSO_4$ as an insolubility, and the

$PbSO_4$ adheres on two electrodes. In a case of the discharge of battery, sulfuric acid is consumed and water is generated. Since a density of water is about 70 percent for a density of the sulfuric acid solution, a charging state of the battery can be noted when a density of electrolyte is measured. Also, in a re-charge of the battery a reaction of the electrode becomes an inverse reaction.

However, during charging/discharging cycles for a long time, it occurs such a case that the sulfate adhered in the case of the discharge containing its independent discharge is not detached in a charge case, namely, the sulfate adheres thereon as it is. Such case is called as a sulfuric-acidification or lead sulfate phenomenon. The more the battery is getting discharged and the more the number of the charging/discharging cycles becomes many, the more the sulfuric-acidification phenomenon becomes serious. Thus, such phenomenon causes that over 80 percent among general lead storage batteries is scrapped.

The sulfate SO_4 is an insulation layer covering the polar plate, which is a film type provided through a combination with the polar plate and through a combination of the sulfate SO_4 and the sulfate SO_4 on an activated material layer. That is, a path for a chemical and electric reaction is cut off and an insulation function is performed, to thereby cause not only a drop in voltage, a capacity and a specific gravity extent of the battery but also a removal of the sulfur molecule forming the sulfuric-acidification of the battery from the electrolyte. This case provides a non-efficiency of the electrolyte. In order that the battery receives charging current and furnishes strength discharging current, it is very important an existence or non existence of a clean polar plate and strength electrolyte. A battery under the lead sulfate phenomenon can not perform any one out of its own operations. As above-mentioned, it is available to partly remove the sulfate in a case of a powerful re-charge but difficult to remove it completely. Ultimately, after some discharging cycles, the polar plate of the battery is covered with the sulfate which

makes an efficient re-charge impossible or the polar plate is corroded, finally the battery is scrapped.

Such lead sulfate phenomenon affects a load test of the battery in a bad condition. For example, phenomena that the polar plates of the battery are seriously corroded and material of the polar plates is sunk onto the bottom of the battery, occur because it is manufactured by a high porosity in order to maximize the surface area of the polar plate and discharge current in the highest rate in a short time, that is to say, it is manufactured so that a high current capacity may be generated in a short time in the structure of a small-size battery. The sulfate is entered inside holes of the polar plate till its crystallized state and is expanded rapidly, then as above-mentioned, it destroys the activated material layer of the polar plate so as to fall away therefrom, finally a deterioration and a life shortening of the battery are caused. Further, a corrosion of the polar plate occurs in a low charging state of the battery. If according to a theory for the battery, cell voltage should reach 2.5 bolt per cell to maintain a shape of a negative pole plate. This, for example, means around 15 bolt in a case of a 12 bolt battery, and in case it is not satisfied, a negative pole panel leaves in a weak state, thus the negative pole panel is easy to corrode by a shaking of vehicles, etc.

In a general automobile system, a voltage adjusting equipment does not exceed 14.2 bolt in general, in other words, in order to maintain a charge state of a 12 bolt battery, voltage of 14.1 bolt should be received at minimum, but the highest voltage of the battery in the vehicle is only 13.9 bolt in a state that there is no a specific load. Herewith, in case that an electric load such as a heater or an equalizing equipment etc. is added, voltage falls to 13.7 bolt. Therefore, a low-charged state of battery is continued to cause shorten its life rapidly.

Accordingly, conventionally a polar plate of a battery I covered with sulfate which makes an effective re-charge impossible, or the polar plate corrodes, finally a life of the battery is rapidly shortened to thus cause a scrap of the battery in a short

time.

SUMMARY OF THE INVENTION

Accordingly, the present invention is directed to a life span lengthening device for an efficient use of a battery that substantially obviate one or more of the limitations and disadvantages of the related art.

A primary object of the present invention is to provide a life span lengthening device of a battery, which is capable of improving a performance of a battery and lengthening its life by removing sulfate adhering on a polar plate of the battery so as to maintain a clean polar plate and strength electrolyte.

To achieve these and other advantages, and in accordance with the purpose of the present invention as embodied and broadly described, the life span lengthening device of a battery comprises a state monitoring part for sensing a case that voltage higher than maintenance voltage of the battery is applied to an interval of first and second power terminals of the battery and generating a driving signal; and a pulse generating part for generating direct

current pulse in response to the driving signal of the state monitoring part and providing it to the first power terminal of the battery.

In accordance with the present invention, further, a method of supplementing a charge of a rechargeable battery comprises the steps of: receiving charging voltage in charging the battery; gaining reverse electromotive force by periodically switching the charging voltage and generating rectangular wave pulse of a band corresponding to several tens of kilo hertz; and successively providing the rectangular wave pulse to a positive pole plate through a positive pole of the battery.

Accordingly, the sulfate adhering onto the polar plate of the battery is eliminated and this sulfate is returned as activated sulfur molecule to the electrolyte to thereby improve a performance of the battery.

BRIEF DESCRIPTION OF THE ATTACHED DRAWINGS

The accompanying drawings, which are included to provide a further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate embodiments of the invention and together with the description serve to explain the principles of the invention.

In the drawing:

Fig. 1 depicts a block diagram of a circuit based on an embodiment of the present invention.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENT

Reference will now be made in detail to the preferred embodiments of the present invention, examples of which are illustrated in the accompanying drawings.

Fig. 1 illustrates a block diagram of a circuit provided inan embodiment of the present invention. A life span lengthening device 2 connected to a battery 1 is constructed by a state monitoring part 30 and a pulse generating part, the pulse generating part being as the rest constructive element excepting the state monitoring part 30.

The state monitoring part 30 is composed of a voltage detector for detecting voltage between first and second power terminals of the battery, and a driving switch operated in case that output voltage from the voltage detector is higher by over a given level than maintenance voltage of the battery, for outputting a driving signal; and with such construction, the state monitoring part 30 senses a case that voltage higher than the maintenance voltage of the battery 1 is applied to the interval of the first and second power terminals +, -, and generates the driving signal. The voltage detector is constructed by a diode 32 connected to the first power terminal in a forward direction, a resistance 34 whose one end is connected to the diode 32 and a variable resistance 36 connected with another end of the resistance 34 and the ground. The driving switch 38 is constructed by a transistor "2SC945" in which a base is connected to the variable resistance, an emitter is connected to the ground, and the driving

signal is provided to a collector.

The pulse generating part is composed of an oscillator 20 for generating a clock signal which oscillates in given frequency in response to the driving signal; a switch 40 for performing a switching operation in response to the clock signal of the oscillator; and a DC pulse generator 10 connected between the first power terminal and an output terminal of the switch, for generating direct current(DC) pulse by reverse electromotive force of coil generated according to the switching operation of the switch, thereby the pulse generating part generates the DC pulse in response to the driving signal of the state monitoring part and furnishes it to the first power terminal of the battery. The oscillator 20 is constructed by an integrated circuit "4584" for use of an oscillation, the integrated circuit "4584" being for generating frequency around 10.1 kilo hertz (KHz). The switch 40 is constructed by a transistor "IRF540" in which an emitter is grounded, a base is connected to an output of the oscillator and a collector is connected to the DC pulse generator. The DC pulse generator 10 includes a diode 12 connected between the first power terminal and an output terminal of the switch in an inverse direction; a resistance 14 whose one end is connected to a cathode of the diode 12; a capacitor 16 connected between another end of the resistance 14 and the ground; and an inductor coil 18 connected between another end of the resistance 14 and the output terminal of the switch 40. Herewith, a resistance 39 is the resistance for shielding current.

The battery 1 applied by the inventive life span lengthening device 2 is as a rechargeable battery, and it is available to contain all kinds of batteries for use in an automobile such as a general passenger car, a freight car, a bus etc. or batteries for use of an industry. The life span lengthening device 2 is installed on a constant portion, desirably on an upper part, of the battery 1.

Operations of the life span lengthening device 2 with such construction are described as follows, for example, for a case that the life span lengthening device 2 is set onto a battery of a general passenger car.

The maintenance voltage of the battery 1 generally is under about 12.5 bolt in a state that a starting engine of the car is turned off. Therefore, the state monitoring part 30 shown in Fig. 1 senses that voltage applied to an interval

of the first and second power terminals +,- of the battery 1 is 12.5 bolt, so does not generate the driving signal. That is, describing it in detail, reference voltage for deciding a turn-on condition of the transistor 38 as the driving switch is determined by the diode 32, the resistance 34 and the variable resistance 36, which are provided within the voltage detector. Thus, if the variable resistance 36 is controlled in advance so that the transistor 38 is turned on about 13.2 bolt, the transistor 38 maintains a turn-off state since it is under 12.5 bolt in the state that the starting engine is turned off. According to that, current does not flow to the emitter terminal, though a collector terminal of the transistor 38 is provided with voltage under 12.5 bolt. Since it herewith becomes a "HIGH" state in a logic level of voltage, the oscillator 20 within the pulse generating part is turned off so as not to perform an oscillation operation, and according to that, a logic level "LOW" is applied to the base of the transistor 40 as the switch, so the transistor 40 is turned off. Thus the transistor 40 can not perform a switching operation, in other words, the reverse electromotive force is not generated in the coil 18 provided within the DC pulse generator 10. Accordingly, in case the starting engine is turned off, all of interior operations in the life span lengthening device are a cut-off state, so there hardly is consumed current.

When the starting engine of car is set, a generator or an alternator within an engine room of the passenger car generally executes a three-phase alternating current(AC) generation. A rectifier within the generator performs a rectifying operation for a conversion into direct current, then a voltage regulator receiving the DC outputs the DC of about 13.2 to 13.8 bolt as voltage for use of the charge, the rectifier being for changing the AC generation to the DC voltage. Therefore, the state monitoring part 30 shown in Fig. 1 senses that voltage applied to the

interval between the first and second power terminals +,- of the battery 1 is over 13.2 bolt, and generates the driving signal. Describing in detail, the transistor 38 is turned on, since the variable resistance 36 is controlled so that the transistor 38 is turned on around 13.2 bolt. That is, the current flows from the collector terminal to the emitter terminal and voltage of the collector terminal drops to a ground level. This becomes a "LOW" state in the logic level of voltage, thus the oscillator 20 within the pulse generating part is turned on to perform the oscillating operation. Herewith, inverters 22,24 provided within the oscillator 20 are represented as a form of an equivalent circuit and are as an integrated circuit "4584" for the oscillation, the integrated circuit "4584" being determined so as to generate frequency of around 9 to 12 KHz. Accordingly, a logic level "HIGH" is applied to the base of the transistor 40 by a period of about 10 KHz, and the transistor 40 is then turned on. That is, the transistor 40 alternately performs the turn-on/off switching operations in the frequency of about 10KHz. According to that, a path of current is formed with such frequency and is then cut off, the current being reached the ground via the paths of the diode 12, the resistance 14, the capacitor 16, the inductor coil 18, the collector of the transistor 40 and the emitter of the transistor 40, in order. Such form and cut-off operations for the path are repeated, and whenever such form/cut-off operation, the reverse electromotive force is generated on the coil 18 provided within the DC pulse generator 10, and this reverse electromotive force is then supplied as DC pulse to the first power terminal + of the battery 1. In this case, a path to which the DC pulse is applied, is provided from a node N1 to the first terminal + through the diode 12. Thus, the rectangular wave pulse over about 13.2 bolt is successively supplied in several tens of kilo hertz to the positive pole plate through a positive pole of the battery. This rectangular wave pulse herewith is current of about 2A(ampere). According to that, the sulfate accumulated on the polar plate of the battery and crystallized, is re-activated and becomes the activated sulfur molecule, and is then returned to the electrolyte as solution of the battery.

In a case of a battery for use in an industry, meanwhile, it is desirable to discharge pulse of powerful 4A, and its variety may be applied to the invention by a sort of use batteries. Further, in a generation of the pulse, namely, momentary cell voltage during the pulse generation rises more rapidly than the general battery voltage, and this momentary and successive pulse voltage eliminates the lead sulfate and maintains a form of the negative pole plate as it is, to thereby make the battery an optimum state.

In accordance with the present invention, as afore-mentioned, a capacity in a battery increases and a specific gravity of electrolyte is recovered, to thus provide more powerful strength in the battery. In addition, a rise of voltage provides not only the maximum efficiency of the battery but also an effect that maintenance and repair expenses for the battery is remarkably curtailed. Therefore, in applying the invention to batteries of a car, a charging time during driving is shortened, thus a load to a generator is reduced, whereby engine fuel such as gasoline, diesel fuel, gas etc. can be saved.

Furthermore, in a case of a power voltage battery, the structure of its polar plate is a shape of a tube which has not a nature of a porosity, and this battery also has a nature to discharge a large quantity of current through a long time. Because a physical size of the polar plate is very large, the sulfate can only insulate the exterior of the polar plate, which makes an efficient charge of the battery difficult. In applying the invention to this case, the lead sulfate is eliminated by performing a charge and discharge only two times and its electrolyte is strengthened, thereby it is available to reuse the battery.

Additionally, during a severe discharging period, a polarity of several polar plates within cells may be changed. During a recharge, such cells should definitely receive energy in order to return a state of zero, and when it first becomes a normal polarity, its charge starts, and an efficient recharge is performed since it is not necessary that neighboring cells are returned to the zero state. However, since the cells having the polar

plates of such inverted polarity suppress voltage of a battery and make a charger provide the strength current, the completely charged cells represent a severely boiled condition, which causes a potentially mechanical damage upon the battery. Herewith, in a case of applying the invention thereto, this problem can be settled.

It will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without deviating from the spirit or scope of the invention. It was herein described with the example of a case that the inventive device was installed in the battery of the passenger car, but in other case, not only a range of pilot voltage in a state monitoring part can be increased or decreased, but also generation frequency of direct current pulse can be changed. Thus, it is intended that the present invention cover the modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.

What is claimed is:

1. A life span lengthening device installed on a battery which is chargeable, for an efficient use of the battery, comprising:

a state monitoring part for sensing a case that voltage higher than maintenance voltage of said battery is applied to an interval of first and second power terminals of the battery, and generating a driving signal; and

a pulse generating part for generating direct current(DC) pulse in response to the driving signal of the state monitoring part and providing it to the first power terminal of the battery.

2. The device of claim 1, wherein said pulse generating part comprises:

an oscillator for generating a clock signal oscillating in given frequency in response to the driving signal;

a switch for performing a switching operation in response to the clock signal of said oscillator; and

a direct current pulse generator connected between the first power terminal and an output terminal of the switch, for generating the DC pulse by reverse electromotive force of coil generated according to the switching operation of the switch.

3. The device of claim 1, wherein said state monitoring part comprises:

a voltage detector for detecting the voltage between the first and second power terminals of the battery; and

a driving switch operated in case that output voltage from said voltage detector is higher by over a given level than maintenance voltage of the battery, for outputting said driving signal.

4. The device of claim 2, wherein said oscillator is provided as an integrated circuit "4584" for use of an oscillation, for generating frequency

around 10 kilo hertz (KHz).

5. The device of claim 2, wherein said switch is provided as a transistor "IRF540" in which an emitter is grounded, a base is connected to an output of said oscillator and a collector is connected to the DC pulse generator.

6. The device of claim 2, wherein said DC pulse generator includes:

a diode connected between the first power terminal and the output terminal of the switch in an inverse direction;

a resistance whose one end is connected to a cathode of the diode;

a capacitor connected between another end of the resistance and the ground; and

an inductor coil connected between another end of the resistance and the output terminal of the switch.

7. The device of claim 3, wherein said voltage detector includes:

a diode connected to the first power terminal in a forward direction;

a resistance whose one end is connected to said diode; and

a variable resistance connected with another end of the resistance and the ground.

8. The device of claim 3, wherein said driving switch is provided as a transistor "2SC945" in which a base is connected to the variable resistance, an emitter is connected to the ground and the driving signal is provided through a collector.

9. The device of claim 1, operated in case that the maintenance voltage of said battery is about 12.5 bolt and said driving signal is thus generated at over about 13.2 bolt.

10. The device of claim 1, wherein said second power terminal is a

negative pole - in case that said first power terminal is a positive pole +.

11. A life span lengthening device of a battery installed on the battery for use in vehicles, for an efficient use of the battery, comprising:

a state supervisory part for generating a driving signal in only case that the battery is charged by charging means of the vehicle; and

a pulse originating part for generating rectangular wave pulse of about several tens of kilo hertz band in response to the driving signal of the state supervisory part and successively providing the rectangular wave pulse to a positive pole plate through a positive pole of the battery.

12. A life span lengthening device of a battery installed on a lead storage battery for use in a passenger car, for an efficient use of the battery, comprising:

a supervisory part for checking such a state that the battery is under a state of being charged by a generator of the passenger car; and

a pulse generating part operated in only a case that said supervisory part checks the charging state, for generating rectangular wave pulse of about several tens of kilo hertz band, over about 13.2 bolt, and successively providing it to a positive pole plate through a positive pole of the battery.

13. A method of supplementing a charge of a rechargeable battery comprising the steps of:

receiving charging voltage in charging the battery;

gaining reverse electromotive force by periodically switching the charging voltage and generating rectangular wave pulse of several tens of kilo hertz band; and

providing successively the rectangular wave pulse to a positive pole plate through a positive pole of the battery.

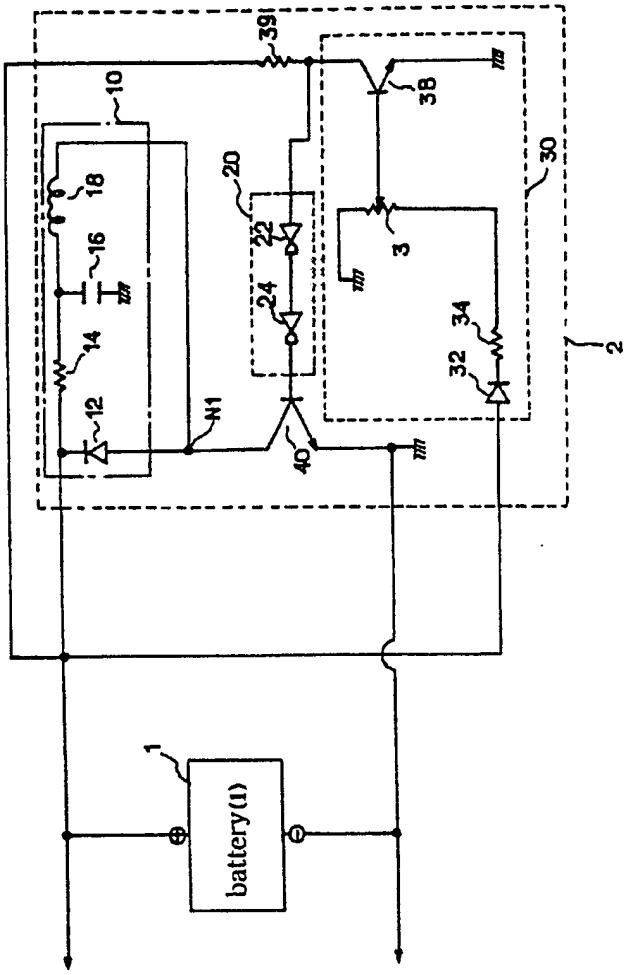

FIG. 1

INTERNATIONAL SEARCH REPORT

international application No.
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A. CLASSIFICATION OF SUBJECT MATTER

IPC7 H01M 10/46

According to International Patent Classification (IPC) or to both national classification and IPC

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IPC7 H01M

Documentation searched other than minimun documentation to the extent that such documents are included in the fileds searched

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Electronic data base consulted during the intertnational search (name of data base and, where practicable, search trerms used)

IEL(IEEE/IEE Electronic Library), Since 1988, lead <and> battery <and> sulfate
http://www.patents.ibm.com, desulf* <and> battery <and> lead

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Nelson, J. P. ; Bolin, W.D. 'Basics and advances in battery systems' Industry Applications, IEEE Transactions on Published: March-April 1995 Volume: 31 2 , Page(s): 426-427	1-2, 11
Y	US 5,063,341 A(Carl E, Gali), 5 November 1991 See abstract	11

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
02 JUNE 2000 (02.06.2000)	05 JUNE 2000 (05.06.2000)

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